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writer describes the route from Lao-Kai on the Red river of Tonquin, to Mengtsze in Yunnan. He is not enthusiastic about any of the routes from Tonquin, though he thinks France has as much chance of getting the China trade as any of her rivals. The route from Lao-Kai to Manhao is by river, but from the head of navigation to the plateau of Yunnan the coast is extremely difficult and mountainous.——Commander Réveilliere has succeeded in passing the rapids of the Meikong, beyond Samboc, the chief Cambodian town on the river, in a steamer. These rapids are at present a bar to navigation, but M. Réveilliere is convinced that it is formed of nothing more than a mass of trees permanently freed and added to every year. The town of Strung-Treng where most of the commerce of the Laos reaches the river, is above the rapids.

GEOLOGY AND PALÆONTOLOGY.

THE ENGLISH CRETACEOUS.—With the Cretaceous, or rather with that indefinite age which intervened between the close of the Cretaceous and the dawn of the Eocene, unrepresented by any stratified rock in England, we close the book on the evolution of Gymnosperms for nearly all the archaic anomalous genera which held the place of our larches, pines and spruces, cypresses and junipers, had given way to living genera and even species.

It is a remarkable fact that the extermination of so much that was preëxisting of both the marine and terrestrial fauna, embracing nearly all the armoured cephalopods and the gigantic saurians which had till then occupied the foremost place, should have been accompanied by a similar wholesale disappearance among plants. To suppose that this period was an exceptionally fatal one, annihilating entire orders of the animal kingdom, is to admit, in the complete absence of evidence, a break or jerk in the majestic progress of life upon the earth which is repugnant to common sense; and it is more consonant with our present views to suppose that we are in presence of one of those vast gaps in the geological record which we know must have occurred over and over again in every area upheaved upon which sedimentary rocks had been deposited. In turning from the last Cretaceous deposit in Europe, we seem, so far as the plant world is concerned, to finally break with the past, while the first deposit of the Eocene appears like turning over the first page of the history of things as we see them now. It is thus, perhaps, worth our while to turn aside for a moment to take stock as it were of the closing events of the Cretaceous, so far as we know them at present, in order to estimate the true nature of the apparently sudden bound in the usually stately unarmed progress of evolution.

It appears that during the chalk formation a great wave of depression passed across Europe, traveling from the West to the East, permitting the ingress of the Atlantic, and forming a gulf over what is now Central Europe, which constantly increased in magnitude. We need not believe that this gulf was formed by any sudden catastrophe, for there is no reason to doubt that the sea conquered the land by the same methods and at somewhere about the same rate that it encroaches now, and that therefore its advance over many thousands of square miles of *terra firma* would be an exceedingly lengthened process. We cannot gauge the time this occupied, but we know that since the appearance of man Southampton water has been formed, and a tract between Alum bay and Studland, some fifteen miles long and five or six miles broad, has been swept into the sea, and several species like the mammoth have become extinct. The rate of the encroachment depends mainly on that of the subsidence and the original height of the land, but what has here been effected in a subsidiary area serves to show roughly how vast a time must have been needed for the chalk sea to have crept from Kent to the Crimea, and covered the enormous area of Europe over which its traces still remain. As the land subsided and became sea, blue and green muds were thrown down, to be succeeded in due course by the deeper deposits of chalk ooze. It would be physically impossible for chalk, supposing it to represent globigerina ooze,[1] to be directly formed on a former land surface, and we consequently find that it is invariably preceded by some more littoral quality of sediment. The nearer the original centre of depression or focus of subsidence, the older the green sands and Gaults must necessarily be; and the farther we recede from it in any landward direction the newer they will be. Now, apart from physical evidence, a comparison of the faunas of our chalk with those of any European bed correlated with it to the eastward would at once show that if one was older than another, it would be that of our area. Forms like Mosasaurus, which only appear in our very latest chalk deposits, abound in Cretaceous deposits of more central Europe; whilst others, such as Ichthyosaurus, found abundantly in our chalk marl, are, on the contrary, absent. The rapid increase in the development and proportion of long canaled and other Eocene-looking gastropods, culminating in the Danish Upper Chalk, indicates most conclusively a more and more recent period of deposition for the beds in which they occur. The littoral zone must in fact have been constantly traveling outward and forward, and accumulating only until the ever-increasing depth led to a change in the sediment. Thus, though beds of green sand or chalk may be perfectly continuous, with precisely the same lithological characters, it is absurd to assert that portions of it, when separated from each other by degrees of latitude and longitude, must be synchronous. So far from this, the chalk with flints of one locality must most certainly have been deposited synchronously with the chalk of another, and this in turn with the chloritic marl of another, and the greensand of another. The shallower water zones, such as the greensand, would travel forward so long as the sea continued to encroach, and along the farthest confines of the gulf would recede again when elevation set in without any chalk being deposited over them, so that some upper greensands might be newer than any chalk. It is probable that each minor zone was a zone of depth, characterised by the same quality of sediment, and a fauna to some extent peculiar to it, and which kept up with it as it traveled farther and farther landwards. There would thus be great similarity in the fauna of each zone at any interval of distance, and it might maintain its distinct charcteristics over the most extensive areas, without, for all that, its contents having lived synchronously over the whole area.

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[1] True chalk is a pure white limestone, composed of the remains of Foraminifera, valves of Cytherina, excessively minute infusoria, cell prisms of Inocerami, sponge spicules, and other debris of organic life. It was, until recently, universally admitted to be a truly oceanic deposit, of similar nature to globigerina ooze, but Mr. Wallace, supported by the late Dr. George Jeffreys, has lately put forward the view that it was formed in shallow water. Its vast extent, homogeneous nature, and freedom from terrestrial impurity show that it must have been formed remote from land, while its larger organisms, mainly Echinodermata or sponges, are with some exceptions, such as are now met with in abyssal depths. Mr. Wallace laid some stress on the difference in composition of fresh globigerina ooze and chalk, as shown by analysis; but Mr. Murray has recently stated that the percentage of carbonate of lime varies from 40 to 95 in the ooze. The comparison took no account of the fact that the chalk had been elevated for ages, during which it has been ceaselessly removing some of its original constituents. Silica has been dissolved and re-precipitated as flint, its iron has been segregated into crystalline masses, its manganese into dendritic markings, siliceous sponge skeletons have been dissolved and replaced by calcite, calcite shells by silica, and aragonite shells removed entirely. Layers of chalk a foot in thickness have been reduced to an inch by the removal of lime in solution. The late Dr. George Jeffreys had not studied the chalk, and based his conclusion upon the mollusca only, and these chiefly of the chalk-marl, and seemed unaware that only the calcite shells remained in true chalk. Of these Terebratula, Pecten, Amussium, Lima, and Spondylus are the chief genera still existing, and all but the last are already known to inhabit water 1400 fathoms in depth. Moreover, if the chalk sea did not communicate with the Arctic ocean, as Prof. Prestwich and others believe, and was shut off from the Antarctic by land between Africa and South America, as there is also much evidence to support, its abyssal depths would have been warm instead of icy cold, and its former abyssal inhabitants, accustomed to warmth, would have sought shallower water now in order to find an equal temperature, and become, as George Jeffreys states them to be, a tropical assemblage. The blue and green muds of the *Challenger* pass into globigerina ooze with an increased depth, and their equivalents of Gault and greensand pass into chalk in exactly the same way. The alternative theory of Wallace, that chalk is decomposed coral mud, could not have been advanced by a geologist, as, while the chalk contains some well-preserved solitary corals, not a reef-building coral has ever been met with either in or surrounding it, nor even in any contemporaneous deposit.

We have noticed that the Neocomian and Gault of England and Western France contain a varied and considerable flora, represented mainly by foliage and fruits of Coniferæ, without affording the slightest trace of the presence of angiospermous dicotyledons. Even the Gray Chalk and the Blackdown beds have only yielded conifers and a Williamsonia of Jurassic type. We cannot account for their absence by supposing our area to have been isolated, for in the preceding Wealden period neither its fauna or flora differed from that of Europe. But when we reach Aix-la-Chapelle, we find the chalk and greensand resting upon beds containing a flora largely made up of dicotyledons, and still farther off, in the Cenomania of Bohemia, living genera such as Magnolia, and farther on still, equally developed dicotyledons in the supposed yet older Turanian. Such facts were hitherto completely inexplicable, but it now appears even probable that the interval required for the chalk to progress only 300 or 400 miles endured long enough to have permitted an enormous progress in the evolution of phanerogams. Nor does the 1200 or 1400 feet of vertical chalk remaining in our area at all represent the completed formation; for, as the prolonged subsidence finally ceased and gave place to an equally slow elevation, all the lessening zones of depth would travel back with the receding ocean, and leave a series of zones inversely arranged to that preserved to us. The planing action of the sea has removed all this newer series, just as it has planed away a further mass of the width of the English channel, and is slowly but inexorably cutting down to its own level all the zones that form its shore lines. The Eocene seas from beginning to end of the period were ceaselessly engaged in this work, and their enormous deposits of flint shingle mark how much of the chalk had fallen a prey to them. Nor has the chalk enjoyed any respite from the work of destruction down to the present day, so that what now remains is a mere fragment of what once existed. It was during the interval that elapsed between the formation of the newest chalk now left in England and the oldest Eocene that dicotyledons were introduced, and our existing flora practically came into existence. All the Upper Cretaceous floras of Europe also flourished during this interval, but we cannot say, with our imperfect record, exactly the order in which they came in, and must be content to regard them in a general way as far newer than they appear to be stratigraphically. The entire American Cretaceous series should, perhaps, also be placed somewhere in this interval, though those well qualified to judge regard its commencement as dating from an older period. Without this digression we could not have formed an adequate idea of the meaning of the "Cretaceous period" and so realized that the so-called Cenomanian and Turanian floras of Europe may belong to a completely different epoch to that represented by the same horizons in Kent and Sussex.—*J. S. Gardner.*

ON PROSCORPIUS OSBORNEI WHITFIELD.—In an article with the title: "On a fossil scorpion from the Silurian rocks of America."[1] Mr. Whitfield has recently published a description and figures of a highly interesting animal, the *Proscorpius osborni* Whitf., which he had some time before made known to zoölogists, in a preliminary notice: "An American Silurian Scorpion,"[1] under the name of *Palæophonus osborni.* The animal is no doubt a real scorpion, and not an Eurypterid; but as a few of the characteristics ascribed to it by the author would seem to remove it very far from other scorpions and especially from the Palæophonoidæ, to which it appears to me to be closely related, I venture to offer a few observations on this arachnid, or rather, on Mr. Whitfield's interpretation of certain points in its organization. Of course I give no other weight than that of mere suppositions to the opinions I am going to express, being fully aware of the difficulty and perhaps rashness of offering criticisms on the description of a rather badly preserved fossil, without knowing the "corpus delicti" from actual inspection.

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[1] In Bulletin of the American Museum of Natural History, Vol. I, No. 6, p. 181 (October 10, 1885).

According to Mr. Whitfield, the abdomen (preabdomen) of his scorpion is provided with *six* long and broad ventral plates, and if this were true, this animal would of course be so different from the rest of the order, that it ought perhaps to be considered as the type of a group equivalent to all the other known scorpions taken together; for in all other scorpions there are only *five* such plates, the sixth (reckoned from behind) being reduced to a small sternite, situated between the bases of the pectinal combs. Such a form of the said ventral plate as described by Mr. Whitfield, would no doubt, as he himself aptly remarks, imply great modifications in the position and shape of the pectoral combs of the animal, and probably also in the structure of the whole inferior part of the body in front of the plate in question. But to me it does not seem necessary to admit that Proscorpius differs in so high a degree from other known scorpions. I strongly suspect, that *all* that is seen of the abdomen in Mr. Whitfield's specimen (with the exception only of the narrow border to the left, and, perhaps the posterior part of the equally narrow right-hand border) is formed *exclusively of the dorsal plates.* The whole upper side of the abdomen is broken or cracked longitudinally; the narrower, right-hand part, considered by Mr. Whitfield to be formed of the inside of the *ventral* plates, has perhaps an appearance different from that of the rest of the upper surface, only from having been more strongly depressed and crushed, and the apparently slightly greater lengths (in the antero-posterior direction) of the right-hand parts of the plates would seem to depend on the same cause. This interpretation easily accounts for the circumstance that in Mr. Whitfield's specimen the articulations between *all* the "ventral" plates (not only between the posterior ones) are *direct continuations* of the articulations between the "dorsal" plates, which is not the case in other, at least not in recent, scorpions. In these, in fact, the articulations between the first two or three dorsal plates do not correspond to or are continued by articulations on the ventral side of the body; for in these and perhaps in all scorpions, the dorsal plates increase in length, counting from front backward, so that the first plate is the *shortest* of all; whereas (at least in recent scorpions) the first *ventral* plate is *longer* than the following ones, corresponding in length and position to *two* or even *three* (2d and 3d, or 1st–3d) dorsal plates taken together.[1] If the above given interpretation is, as I believe, the right one, the want of *spiracula* on the plates needs no further explanation.[2]

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[1] In Science, Vol. VII, p. 87 (July 31, 1885).

Mr. Whitfield thinks that, whereas modern scorpions carry the tail (postabdomen) arched upward over the back, Proscorpius, and also Palæophonus, carried it in the opposite way, or curved *downward.* This would indeed be a character of fundamental importance in distinguishing the Silurian scorpions from all other members of the group; but to me it is impossible to find any stringent reason for adopting this strange hypothesis. In the first place, it would seem that the animal's gait would become exceedingly difficult and awkward, if it were to walk with its tail curved under the body; and when it wished to kill, with the sting, the prey which it had caught with the hands of the palpi, it would probably be obliged to thrust the palpus with the prey between its legs, under the body, in order to bring it within the reach of the sting—no doubt a difficult performance for the animal. That in the embryo of scorpions the tail is bent under the body, is of course no reason for believing that the tail retains that position after birth, in the earliest or Silurian species, rather than in Carboniferous and recent ones. As to Palæophonus, I do not entertain the least doubt of its having carried its tail in the same direction as living scorpions. It must be borne in mind that, when a scorpion is strongly depressed or flattened, the tail, on account of its being arched upwards and not allowing of being stretched out in a straight line backwards, cannot well turn the dorsal part of more than its *basal* joints upwards; the following joints become gradually more and more turned to one side or the other, so that the last joint or joints will be seen in profile, or even obliquely from below. Such is the case in the specimen of *Palæophonus nuncius* described and figured by Professor Lindström and myself.[3] The basal joints of the tail of this animal are destroyed but must have turned their upper or dorsal surface upwards, as they have left the impression of their ventral part on

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[1] In a specimen of *Buthus 5-striatus* Hempr. et Ehr., for instance, whose abdomen (preabdomen) is $24\frac{1}{3}^{\text{mm}}$ long, the length of the first ventral plate is 6^{mm}, that of the first three dorsal plates taken together $5\frac{1}{2}^{\text{mm}}$.

[2] Even if the plates in question really were ventral plates, the first (or sixth, when counted from behind forward) would from its position seem to correspond to the anterior half of the first ventral plate in ordinary scorpions, and *not* to the small plate situated between the pectoral combs. The genital plate is, I believe, the sternite of the first *segment* of the abdomen, quite as the plate between the combs is the sternite of its second segment.

[3] Thorell and Lindström, on a Silurian scorpion from Scotland (K. Svenska Vetenskaps-Akademien Handlingar, Bd. 21, No. 9).

the stone; the next following joints are seen from the left side, the two last obliquely from that side and from below. In the Scotch Palæophonus described by Mr. Peach,[1] which is turned upside down, we consequently see that the basal joints of the tail turn their ventral part upward and that the last joints are viewed *obliquely from above.* As to Proscorpius the impression one receives from the figures is, that the tail shows the *dorsal* surface of at least three of the four joints still preserved, just as would be expected. Mr. Whitfield says, however, that it shows, *not* the upper or dorsal surface, but "the inside of the *ventral* or lower plates of the four anterior segments;" and as these plates have the same form and sculpture as the *dorsal* plates or parts of these segments or joints in ordinary scorpions, he concludes that in Proscorpius "the bending of the tail would be downward, and not over the back, as in more recent and living scorpions." Now it seems utterly improbable to me that *Palæophonus nuncius* and *Proscorpius osbornei*, which both belong to the Silurian age and which are in many respects closely related, should differ from each other in so important a particular as the direction of the tail. Perhaps it is not impossible that Mr. Whitfield is mistaken in referring what remains of the tail in his Proscorpius to the *ventral* part of the joints. But even if he is right in this, the fact can easily be explained, if we admit that the tail which, according to Mr. Whitfield himself, is *detached* from the body, or to use his own expression, "slightly displaced in relation to the last segment of the preabdomen," has also become *turned upside down;* in that case the joints of the tail would, when their ventral upturned surface had been destroyed, show the inside of their dorsal surface in precisely that position which Mr. Whitfield attributes to the ventral surface of the joint. That Proscorpius had its tail curved downward is, therefore, by no means proved by Mr. Whitfield's specimen.

As the walking limbs of *Proscorpius osbornei* are in a very bad state of preservation, it is no doubt difficult to decide with certainty whether this animal belongs to the ordinary two-clawed scorpions (Dionychopodes) or to the Apoxypodes, or those Silurian forms which have the tarsi pointed and clawless, or possibly armed with a single claw. Only one of the legs, the left one of the first pair, is, according to Mr. Whitfield, undamaged, and provided at the tip with *two* claws. This assertion, if right, would of course settle the question at once; but a close inspection of the figures of the animal makes me believe that that leg also is incomplete, being broken near the base of one—probably the last—of the joints.[2] The "bifid" ending of the leg on the figures does, in fact, not at all give me the impression of two claws, but resembles closely the also broken end of the right leg of the last pair in the figure of

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[1] Ancient air-breathers, in *Nature*, Vol. XXI, No. 796, p. 297. Jan. 29, 1885.

[2] So it appears at least on pl. 20, fig. 1, in Mr. Whitfield's paper.

Palæophonus nuncius Thor. & Lindstr.[1] The joint was perhaps armed with a strong spine near the base (as is the case with the fifth joint in *Palæophonus nuncius*); at all events, the two joints have no resemblance to the claws of ordinary scorpions. But besides this, there are several other reasons for doubting that Proscorpius belongs to the Dionychopodes. In Palæophonus all the joints with the exception of the last, are *cylindrical* or nearly so; in other scorpions the *tibia* is compressed and *convex longitudinally* on the under side; and in this respect Proscorpius appears to have resembled Palæophonus and not the Dionychopodes. The tolerably well-preserved leg of the first pair of Proscorpius seems to show that most of the joints of the legs have been comparatively *short* in this animal, and in this particular also it resembles Palæophonus and differs from the Dionychopodes. The "crowding forward of the limbs and appendages" depends on the *shortness of the posterior coxæ*, and is a characteristic that distinguishes Proscorpius from the Dionychopodes, but not from Palæophonus. (It is not probable that Proscorpius differed from other scorpions in the number of the joints of the legs; if we assume that in the best preserved leg of Mr. Whitfield's specimen the first joint or coxa is concealed by the margin of the cephalothorax, and that the leg is broken at the base of the last joint, it would seem to consist of seven joints, quite as in all other scorpions.)

Another character, by which Proscorpius appears to be more nearly related to Palæophonus than to other, at least recent, scorpions, consists in *the transverse furrow*, which extends across the cephalothorax, so that its posterior part forms "a broad band, resembling a segment of the preabdomen." *The small size of the dorsal eyes* would seem to be a character, in which Proscorpius differs from the Eoscorpioidæ, to which it is referred by Mr. Whitfield; in this particular it resembles rather Dr. Hunter's and Mr. Peach's Scotch Palæophonus, being, as Mr. Whitfield justly remarks, also in its general aspect more like this scorpion than the probably eyeless Swedish species (*P. nuncius*). But though I believe that Proscorpius is nearly related to Palæophonus, it forms no doubt a good peculiar genus, characterized by the somewhat trilobed anterior margin of the cephalothorax, and more especially by the shape of the fingers of the *mandibles*, which, if they really had such a form in the living animal, as from Mr. Whitfield's figures they appear to have, differ materially from those of Palæophonus and all other known scorpions.

It will be seen from the foregoing lines, that I cannot find that Proscorpius differs essentially from the hitherto known scorpions in other respects than in the somewhat *shorter cephalothorax*, and *perhaps*, in the form of the *mandibles*. Its systematical position appears to me to be in the close vicinity of Palæophonus, and especially of the Scotch scorpion referred to that genus by Mr. Peach. An additional reason to those given above for removing Proscorpius from the Carboniferous Eoscorpioidæ, and for referring this genus to the Apoxypodes, fam. Palæophonoidæ, may be found in its being, geologically speaking, almost contemporary with the Palæophoni, belonging, like these, to the Upper Silurian formation. As the Palæophoni, and all other more recent scorpions, are undoubted land-animals and air-breathers, and, as no traces of branchiæ have been shown to exist in Proscorpius, there is, I believe, no serious reason for considering that this scorpion is an aquatic animal, or that "we have here a link between the true aquatic forms, the Eurypterus and Pterygotus, and the true air-breathing scorpions of subsequent periods," as Mr. Whitfield supposes. Very strange, also, would it be, if the connecting link between the gigantic Eurypterids and the scorpions should be formed of such a little creature as *Proscorpius osbornei*, one of the smallest scorpions hitherto known—especially as this diminutive scorpion lived contemporaneously with the Eurypterids.—*T. Thorell, Sori, Italy.*

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[1] Thorell and Lindström, loc. cit., fig. 1.

AN EXTINCT DOG.—The remains of an extinct type of dog, differing widely from any of the ordinary wild or domestic dogs, have been recently described by Mr. J. A. Allen in the memoirs of the museum of zoölogy at Harvard college. The bones were found in Ely cave, Lee county, Virginia, one of the oldest of a group of caverns in limestone of Cambro-Silurian age described by Professor Shaler, of the geological survey of Kentucky. In general form the new dog was a short-limbed, heavy-bodied animal, resembling in its proportions a badger rather than a dog. The skull has not been found. Mr. Allen refers the remains to a new genus, under the name of *Pachycyon robustus.*

MINERALOGY AND PETROGRAPHY.[1]

TIN.—In the "Mineral Resources of the United States, calendar years 1883 and 1884,"[2] W. P. Blake describes the occurrence of "tin-stone," two miles from Harney city, in the Black hills, Dakota. This locality was discovered in June, 1883. During the following year a company was formed to mine the ore, and enough progress was made to show that the find was commercially of much importance. The ore is found in two distinct forms, viz: massive, in bunches with spodumene, feldspar and quartz; and granular, disseminated in greisen.[3] The principal vein, known as the Etta, is described as having a rudely concentric structure. The outer portion consists of a mixture of dark and light colored

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[1] Edited by W. S. BAYLEY, Johns Hopkins University, Baltimore, Md.

[2] Washington, Government Printing Office, 1885.

[3] A rock with the microscopic characteristics of ordinary greisen, but containing albite instead of quartz.